CLAIMS

What is claimed is:

1. A method of electroplating an alloy comprising nickel, cobalt, and boron comprising:

providing an electroplating bath comprising an anode, a cathode, water, ionic nickel, ionic cobalt, ionic boron, and at least one brightener selected from the group consisting of sulfur containing brighteners and organic brighteners; and

applying a current to the electroplating bath whereby the alloy comprising nickel, cobalt, and boron forms on the cathode.

2. The method of claim 1, wherein the electroplating bath comprises at least one sulfur containing brightener selected from the group consisting of sulfinic acids, sulfonic acids, aromatic sulfonates, aromatic sullfinates, sulfonamides, sulfonimides, sulfimides, and sulfo-betaines.

3. The method of claim 1, wherein the electroplating bath comprises at least one organic brightener selected from the group consisting of acetylenic alcohols, ethylenic alcohols, acetylenic amines, acetylenic esters, acetylenic sulfonic acids and sulfonates, alkoxylated acetylenic alcohols, acetylenic carboxylic acids, coumarins, aldehydes, compounds containing a C≡N linkage, and N-hetercyclics.

4. The method of claim 1, wherein the electroplating bath comprises about 10 g/l or more and about 150 g/l or less of ionic nickel, about 0.5 g/l or more and about 70 g/l or less of ionic cobalt, about 0.1 g/l or more and about 20 g/l or less of ionic boron, and from about 0.001 % to about 5 % by weight of at least one brightener.

5. The method of claim 1, wherein the electroplating bath has a pH from about 2 to about 6 and a temperature from about 10 °C. to about 90 °C., and a current density of about 1 ASF or more and about 500 ASF or less is applied to the electroplating bath.

6. The method of claim 1, wherein the electroplating bath is provided by combining water; at least one nickel compound selected from the group consisting of nickel acetate, nickel acetylacetonate, nickel ethylhexanoate, nickel carbonate, nickel formate, nickel nitrate, nickel oxalate, nickel sulfate, nickel sulfamate, nickel sulfide, nickel chloride, nickel fluoride, nickel iodide, nickel bromide, nickel oxide, nickel tetrafluoroborate, nickel phosphide, and hydrates thereof; at least one cobalt compound selected from the group consisting of cobalt acetate, cobalt acetylacetonate, cobalt ethylhexanoate, cobalt carbonate, cobalt nitrate, cobalt oxalate, cobalt sulfate, cobalt chloride, cobalt fluoride, cobalt hydroxide, cobalt iodide, cobalt bromide, cobalt oxide, cobalt boride, cobalt tetrafluoroborate, and hydrates thereof; at least one boron compound selected from the group consisting of boron nitride, boron trichloride, boron trifluoride, boron triiodide, boron tribromide, boron oxide, boron phosphate, dimethylamine borane, morpholine borane, dimethylamino borane, dimethylsufide borane, t-butylamine borane, ammonia borane, N,N-diethylaniline borane, diphenylphosphine borane, dimethylaminopyridine borane, ethylmorpholine borane, methylmorpholine borane, 2,6-lutidine borane, morpholine borane, oxathiane borane, phenylmorpholine borane, pyridine borane, tetrahydrofuran borane, tributylphosphine borane, triethylamin borane, trimethylamine borane, borax, and hydrates thereof; and at least one brightener.

7. The method of claim 1, wherein the anode comprises at least one of nickel, cobalt, boron, iridium oxide, platinum, titanium, graphite, carbon, and platinum-titanium.

8. The method of claim 1, wherein the nickel cobalt boron alloy comprises about 2 % by weight or less of components other than nickel, cobalt, and boron.

9. A method of forming an alloy comprising nickel, cobalt, and boron comprising:

providing an electroplating bath comprising an anode, a cathode, water, about 40 g/l or more and about 100 g/l or less of ionic nickel, about 1 g/l or more and about 30 g/l or less of ionic cobalt, and about 0.1 g/l or more and about 10 g/l or less of ionic boron, and from about 0.005 % to about 2.5 % by weight of at least one brightener selected from the group consisting of sulfur containing brighteners and organic brighteners; and

applying a current to the electroplating bath whereby the alloy comprising nickel, cobalt, and boron forms on the cathode.

10. The method of claim 9, wherein the electroplating bath has a pH from about 3 to about 5 and a temperature from about 30 °C. to about 80 °C., and a current density of about 10 ASF or more and about 200 ASF or less is applied to the electroplating bath.

11. The method of claim 9, wherein the electroplating bath comprises at least one sulfur containing brightener selected from the group consisting of sulfinic acids, sulfonic acids, aromatic sulfonates, aromatic sullfinates, sulfonamides, sulfonimides, sulfimides, and sulfo-betaines.

12. The method of claim 9, wherein the electroplating bath comprises at least one organic brightener selected from the group consisting of acetylenic alcohols, ethylenic alcohols, acetylenic amines, acetylenic esters, acetylenic sulfonic acids and sulfonates, alkoxylated acetylenic alcohols, acetylenic

carboxylic acids, coumarins, aldehydes, compounds containing a C≡N linkage, and N-hetercyclics.

13. The method of claim 9, wherein the electroplating bath comprises a sulfo-betaine brightener.

14. The method of claim 9, wherein the electroplating bath comprises an acetylenic brightener.

15. The method of claim 9, wherein the electroplating bath comprises an N-hetercyclic brightener.

16. A method of plating a substrate with a nickel cobalt boron alloy comprising:

providing an electroplating bath comprising an anode, a cathode substrate, water, ionic nickel, ionic cobalt, ionic boron, and at least two brighteners selected from the group consisting of sulfur containing brighteners and organic brighteners; and

applying a current to the electroplating bath whereby a nickel cobalt boron alloy forms on the cathode substrate.

17. The method of claim 16, wherein at least one of the two brighteners is selected from the group consisting of sulfinic acids, sulfonic acids, aromatic sulfonates, aromatic sullfinates, sulfonamides, sulfonimides, sulfimides, and sulfo-betaines.

18. The method of claim 16, wherein at least one of the two brighteners is selected from the group consisting of acetylenic alcohols, ethylenic alcohols, acetylenic amines, acetylenic esters, acetylenic sulfonic acids and sulfonates,

alkoxylated acetylenic alcohols, acetylenic carboxylic acids, coumarins, aldehydes, compounds containing a C≡N linkage, and N-hetercyclics.

19. The method of claim 16, wherein the electroplating bath has a pH from about 3.5 to about 4.5 and a temperature from about 40 °C. to about 70 °C., and a current density of about 20 ASF or more and about 100 ASF or less is applied to the electroplating bath.

20. The method of claim 16, wherein the electroplating bath comprises from about 0.01% to about 1% by weight of at least two brighteners.

21. The method of claim 16, wherein the electroplating bath further comprises at least one conductivity salt.

22. The method of claim 21, wherein the conductivity salt is selected from the group consisting of boric acid, sodium sulfate, sodium chloride, potassium sulfate, and potassium chloride.